CLAIMS

[Claim(s)]
[Claim 1]An optical element being the reforming layer characterized by comprising the following which it consisted of surface layers, and refining of the surface of a substrate was carried out by plasma irradiation or ion irradiation as for said surface layer, and was formed.
A substrate made of polymer resin.
A different optical property from said substrate formed in the surface of this substrate.

[Claim 2]The optical element according to claim 1, wherein a refractive index of a surface layer differs from a refractive index of a substrate.
[Claim 3]An optical element given in either claim 1 having a refractive index characteristic with a heterogeneous surface layer, or claim 2.
[Claim 4]The optical element according to any one of claims 1 to 3, wherein introductory gas containing at least a kind of element chosen from a group which consists of oxygen, fluoride, and carbon is supplied to an ion source and it is generated by plasma or ion irradiated on the surface of a substrate.
[Claim 5]A surface layer which has a different optical property from a substrate made of polymer resin, and said substrate formed in the surface of this substrate, An optical element which consists of a surface coated layer which consists of one layer formed on this surface layer, or two or more layers, and is characterized by said surface layer being a reforming layer which refining of the surface of a substrate was carried out by plasma irradiation or ion irradiation, and was formed.
[Claim 6]The optical element according to claim 5, wherein a refractive index of a surface layer differs from a refractive index of a substrate.
[Claim 7]An optical element given in either claim 5 having a refractive index characteristic with a heterogeneous surface layer, or claim 6.

[Claim 8]The optical element according to any one of claims 5 to 7, wherein introductory gas containing at least a kind of element chosen from a group which consists of oxygen, fluoride, and carbon is supplied to an ion source and it is generated by plasma or ion irradiated on the surface of a substrate.
[Claim 9]The optical element according to any one of claims 5 to 8, wherein a part or all of a surface coated layer is formed under plasma-izing containing at least a kind of element chosen from a group which consists of oxygen, fluoride, and carbon, or an ionized gas atmosphere.
[Claim 10]The optical element according to any one of claims 5 to 9, wherein a surface coated layer consists of a kind of low refractive index layer at least.
[Claim 11]The optical element according to claim 10, wherein a low-refractive-index substance which forms a low refractive index layer is at least a kind of compound chosen from a group which consists of silicon oxide, magnesium fluoride, and an aluminum oxide.
[Claim 12]The optical element according to any one of claims 5 to 9, wherein a surface coated layer consists of a layered product of a low refractive index layer and a high refractive index layer.
[Claim 13]A low-refractive-index substance which forms a low refractive index layer is at least a kind of compound chosen from a group which consists of silicon oxide, magnesium fluoride, and an aluminum oxide, A high refractive index substance which forms a high refractive index layer A mixture of titanium oxide, and zirconium oxide and titanium oxide, Titanium oxide, a mixture of oxidation PURASEOJIUMU, zinc sulfide, cerium oxide, The optical element according to claim 12 characterized by being a kind of compounds chosen from a group which consists of a mixture of zirconium oxide, indium oxide, tin oxide, and indium oxide and tin oxide, and a mixture of tin oxide and antimony, or these mixtures at least.
[Claim 14]Are the method of manufacturing one optical element of claims 5-13, and a substrate made of polymer resin is arranged in vacuum devices provided with an ion source, Introductory gas which contains at least a kind of element chosen from a group which consists of oxygen, fluoride, and carbon is supplied to an ion source, A surface-layer formation process which irradiates the surface of said substrate with plasma or an ion beam containing said element by which it is generated from an ion source, and forms a surface layer, By performing deposition treatment or weld slag coat processing, suspending an exposure of plasma or an ion beam, or continuing an exposure, Accelerating voltage of an ion source in said each process including a surface coated layer formation process which forms a surface coated layer on a surface layer A manufacturing method of an optical element being less than 200V.
[Claim 15]A manufacturing method of the optical element according to claim 14, wherein ion current density in a base material surface from an ion source in each process is more than 50microA/cm^2.
[Claim 16]A manufacturing method of the optical element according to claim 14 or 15, wherein

degrees of vacuum in vacuum devices when irradiating with plasma or an ion beam on the surface of a substrate are $0.8x10^{-4}$ - $4x10^{-4}$Torr.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to an optical element and a manufacturing method for the same.
[0002]
[Description of the Prior Art]in the optical element conventionally carried in the optical system of a camera, a television projector, a copying machine, etc. -- the increase of acid-resisting performance -- acid resisting -- performance -- various kinds of optical properties, such as beam splitter performance, transparent conductive ability, and wavelength division performance, are demanded.
[0003]In recent years, the optical element which consists of a substrate made of polymer resin, such as an acrylic resin and polycarbonate resin, and an optical film formed in the surface of this substrate is known. Since the heat resistance of the polymer resin which constitutes a substrate is lower than glass when carrying out a deer and manufacturing such an optical element, the heating vacuum evaporation means in the inside of a vacuum is inapplicable as a means to form an optical film in the surface of a substrate. Conventionally, the following art is proposed as a method of forming an optical film, for example, an antireflection film, in the surface of the substrate made of polymer resin.
** Art which forms the interlayer who consists of silicon oxide, an aluminum oxide, etc. on the surface of a substrate, and forms an antireflection film on this interlayer further.
** Art which applies organic matter materials, such as silicon resin, on the surface of a substrate, forms a hard court layer, and forms an antireflection film on this hard court layer further.
[0004]
[Problem(s) to be Solved by the Invention]However, it is easy to generate a crack in the optical

film formed since it becomes what has an interlayer's large thickness in the art of **, It has the problem that light transmittance falls by this, and in the art of **, since it is difficult to apply a hard court layer uniformly, it has the problem of being inapplicable to high precision lenses, such as a camera lens and a laser optics element. Thus, in a Prior art, the actual condition is that the satisfying optical element is not provided as what has a good optical property and endurance.

[0005]the acid-resisting performance in which this invention was made based on the above situations, and the 1st purpose of this invention was excellent -- and -- increase -- it is in providing the optical element which has acid-resisting performance, and it can respond to a highly precise optical system, it is moreover hard to generate a crack etc., and has good endurance.

[0006]the acid-resisting performance excellent in the 2nd purpose of this invention -- and -- increase, while having acid-resisting performance, It is in providing the optical element which it excels in wavelength division performances, such as beam splitter performance, reflective mirror performance, transparent conductive ability, a band pass filter, and a dichroic filter, etc., it is moreover hard to generate a crack, and has good endurance.

[0007]The 3rd purpose of this invention is to provide the method of manufacturing the above-mentioned optical element suitably.

[0008]

[Means for Solving the Problem]This invention finds out that a surface layer which has, an optical property, for example, a refractive index, which refining of the surface state is carried out, and are different from the substrate itself by performing plasma irradiation or ion irradiation, is formed in the surface of a substrate made of polymer resin, and is made based on this knowledge.

[0009]An optical element of this invention consists of a surface layer which has an optical property from which a substrate made of polymer resin and said substrate formed in the surface of this substrate differ, and said surface layer is characterized by being the reforming layer which refining of the surface of a substrate was carried out by plasma irradiation or ion irradiation, and was formed.

[0010]It is preferred that a refractive index of a surface layer differs from a refractive index of a substrate.

[0011]It is preferred to have a refractive index characteristic with a heterogeneous surface layer.

[0012]As for plasma or ion irradiated on the surface of a substrate, it is preferred that introductory gas containing at least a kind of element chosen from a group which consists of oxygen, fluoride, and carbon is supplied to an ion source, and is emitted.

[0013]A surface layer which has an optical property in which an optical element of this

invention differs from a substrate made of polymer resin, and said substrate formed in the surface of this substrate, It consists of a surface coated layer which consists of one layer formed on this surface layer, or two or more layers, and said surface layer is characterized by being the reforming layer which refining of the surface of a substrate was carried out by plasma irradiation or ion irradiation, and was formed.

[0014]It is preferred that a refractive index of a surface layer differs from a refractive index of a substrate.

[0015]It is preferred to have a refractive index characteristic with a heterogeneous surface layer.

[0016]As for plasma or ion irradiated on the surface of a substrate, it is preferred that introductory gas containing at least a kind of element chosen from a group which consists of oxygen, fluoride, and carbon is supplied to an ion source, and is emitted.

[0017]As for a part or all of a surface coated layer, it is preferred to have been formed under plasma-izing containing at least a kind of element chosen from a group which consists of oxygen, fluoride, and carbon, or an ionized gas atmosphere.

[0018]It is preferred that a low-refractive-index substance in which it is preferred with which that a surface coated layer consists of a kind of low refractive index layer at least, and it forms a low refractive index layer in this case is especially at least a kind of compound chosen from a group which consists of silicon oxide, magnesium fluoride, and an aluminum oxide.

[0019]It is preferred that a surface coated layer consists of a layered product of a low refractive index layer and a high refractive index layer, and in this case, A low-refractive-index substance which forms a low refractive index layer is at least a kind of compound chosen from a group which consists of silicon oxide, magnesium fluoride, and an aluminum oxide, A high refractive index substance which forms a high refractive index layer A mixture of titanium oxide, and zirconium oxide and titanium oxide, Titanium oxide, a mixture of oxidation PURASEOJIUMU, zinc sulfide, cerium oxide, It is preferred that they are especially a kind of compounds chosen from a group which consists of a mixture of zirconium oxide, indium oxide, tin oxide, and indium oxide and tin oxide and a mixture of tin oxide and antimony, or these mixtures at least.

[0020]A surface layer which has an optical property in which a manufacturing method of an optical element of this invention differs from a substrate made of polymer resin, and said substrate formed in the surface of this substrate, It is the method of manufacturing the above-mentioned optical element which consists of a surface coated layer formed on this surface layer, In vacuum devices provided with an ion source, arrange a substrate made of polymer resin and Oxygen, Introductory gas containing at least a kind of element chosen from a group which consists of fluoride and carbon is supplied to an ion source, A surface-layer formation process which irradiates the surface of said substrate with plasma or an ion beam containing said element by which it is generated from an ion source, and forms a surface layer, By

performing deposition treatment or weld slag coat processing, suspending an exposure of plasma or an ion beam, or continuing an exposure, Accelerating voltage of an ion source in said each process including a surface coated layer formation process which forms a surface coated layer on a surface layer It is characterized by being less than 200V.

[0021]It is preferred that ion current density in a base material surface from an ion source in each process is more than 50microA/cm^2.

[0022]It is preferred that degrees of vacuum in vacuum devices when irradiating with plasma or an ion beam on the surface of a substrate are 0.8×10^{-4} - 4×10^{-4}Torr.

[0023]Hereafter, this invention is explained concretely.

The 1st invention is an optical element which consists of a surface layer which has an optical property from which a substrate made of polymer resin and said substrate formed in the surface of this substrate differ among <1st invention> this inventions.

[0024]As polymer resin which constitutes a substrate of an optical element, an acrylic resin, polycarbonate resin, polystyrene resin, polyether sulfone resin, amorphous polyolefin resin, etc. can be mentioned, for example. Its heat-resistant temperature is high as compared with other resin, and since amorphous polyolefin resin can give a resistance to environment which was excellent in an optical element obtained from water absorption being low, it is [among these] preferred.

[0025]A surface layer which constitutes an optical element is a reforming layer which refining of the surface of a substrate was carried out by plasma irradiation or ion irradiation, and was formed.

[0026]Plasma irradiation or ion irradiation to the surface of a substrate can be performed within vacuum devices as shown in drawing 1. A substrate with which 1 becomes from vacuum devices and A consists of a substrate made of polymer resin in drawing 1, An electron gun used for deposition treatment in which an introductory gas supply source for an ion source for 2 to irradiate the surface of the substrate A with an ion beam, an electrode holder in which 3 supports the substrate A, and 4 to supply introductory gas to the ion source 2, and 5 mention a gas mass flow control valve later, and a flow instrument and 7 mention 6 later, and 8 are crystal oscillator thickness gages.

[0027]Although the ion source 2 is formed in an inside of the vacuum devices 1, as long as it can irradiate the surface of the substrate A with an ion beam, it may be provided in the exterior of the vacuum devices 1.

[0028]Two or more substrates A are supported by the electrode holder 3 in this example. Thus, when irradiating the surface of two or more substrates A with an ion beam simultaneously, it is preferred to make uniform the amount of ion irradiation to each surface by arranging the surface of each substrate A at the equal distance from the ion source 2, or rotating the electrode holder 3. Thereby, an optical element obtained becomes that to which the

performance was equal.

[0029]As introductory gas supplied to the ion source 2 from the introductory gas supply source 4, It is preferred that it is gas which contains at least a kind of element chosen from a group which consists of oxygen, fluoride, and carbon, For example, it is independent, or oxygen gas (O_2), carbon dioxide (CO_2), a steam (H_2O), gaseous carbon tetrafluoride (CF_4), etc. can be mixed and used. Gas of a kind different if needed may be mixed and used, and inactive gas, such as argon gas (Ar) and nitrogen gas (N_2), may be mixed further. When supplying gas which contains oxygen elements especially, it is preferred to supply by the mixed state with inactive gas, such as argon. This is prolonged by 2 to 3 times compared with a case where a filament life of the ion source 2 supplies oxygen gas independently, for example, an exposure of about 50 hours is attained continuously. In this case, as for the mixture ratio of oxygen gas and argon gas, it is preferred that it is O_2:Ar=8:2-3:7 in a capacity factor.

[0030]A degree of vacuum in the vacuum devices 1 a flow of introductory gas It is preferred to set up maintain 0.8×10^{-4} - 4×10^{-4}Torr.

[0031]Introductory gas supplied to the ion source 2 is ionized in the ion source 2. Are [that the lower one of accelerating voltage of the ion source 2 is preferred here from a viewpoint / prevent the charge up of the surface of the substrate A and / of making ion irradiation to the surface equalizing, and] concrete. It is preferred that it is less than 200V. In [supply oxygen gas here by flow 30SCCM as for example, introductory gas, and] a state of 2 - 3×10^{-4}Torr a degree of vacuum, Accelerating voltage of the ion source 2 If it is set as a value exceeding 200V and ion irradiation or plasma irradiation is performed, it does not become a thing of the uniform characteristic, but a surface layer formed will produce the heterogeneity of **0.5 % in reflectance, and will pose a use top problem as an optical element. Accelerating voltage By setting it as a value not more than 200V, the homogeneity of a surface layer formed is maintained and it is the reflectance of a specified wavelength. It becomes 0.1% or less and a problem of use is not produced as an optical element.

[0032]The larger one of ion current from the ion source 2 is preferred from a viewpoint of shortening of irradiation time, and equalization of an exposure, and, specifically, it is preferred that ion current density in a base material surface is more than 50microA/cm^2. It is accelerating voltage here. If it is set as 150V and less than 50microA/cm^2 carries out ion current density, sufficient surface layer will be formed by exposure of not an hour, but decline in reflectance will average by this surface layer by it. It stops to less than 0.5%, and is insufficient practically as an optical element. By making ion current density more than 50microA/cm^2, an average of 1 to 2% of surface layer is formed for decline in reflectance by exposure for about 20 minutes, and practically sufficient acid-resisting performance is obtained.

[0033]An ion beam generated from the ion source 2 is irradiated by the substrate A currently supported by the electrode holder 3. Although it is efficient to perform an exposure of an ion beam continuously, when temperature in the vacuum devices 1 rises and this affects accuracy of form, the ion irradiation effect, etc. of an optical element with radiant heat from a filament of the ion source 2, it may glare intermittently. Although irradiation time changes also with preset values of ion current, it can be freely set up in the range from which desired acid-resisting performance is obtained. However, in order to obtain acid-resisting performance substantially, an exposure for about at least 1 minute is needed.

[0034]without it uses means, such as the usual deposition treatment and weld slag coat processing, by performing processing of these series -- good acid-resisting performance -- and -- increase -- an optical element which has acid-resisting performance can be obtained.

[0035]A heterogeneous surface layer can also be made to form during ion irradiation by changing suitably processing conditions, such as accelerating voltage of irradiation intensity of an ion beam, ion current, and an ion source, and a flow of introductory gas. Accelerating voltage of ion or plasma here. If less than 200V and ion current density glare on condition of low-voltage high electric current more than 50microA/cm^2, on the surface of a substrate, a heterogeneous surface layer will be easy to be formed. When concentration of irradiated element ion was measured by surface analysis (ESCA analysis) after irradiation treatment on the above-mentioned low-voltage high-electric-current conditions, heterogeneity from which near the surface serves as low concentration most, so that it goes by high concentration to an inside was seen notably. An optical element in which it comes to form a heterogeneous surface layer is preferred at a point that an optical property which acid-resisting performance is obtained in a large light wavelength area, and is not obtained in a still more homogeneous surface layer is revealed.

[0036]The 2nd invention is an optical element which comes to form a surface coated layer which consists of one more layer or two or more layers on a surface layer which constitutes the 1st above-mentioned invention among <2nd invention> this inventions.

[0037]As for a surface coated layer which constitutes an optical element, in the 2nd invention, it is preferred to consist of a layered product of a kind of low refractive index layer or a low refractive index layer, and a high refractive index layer at least.

[0038]acid-resisting performance which was further excellent when a surface coated layer consisted of a kind of low refractive index layer at least -- and -- increase -- acid-resisting performance can be given to an optical element. As a desirable low-refractive-index substance which forms a low refractive index layer here, silicon oxide, magnesium fluoride, an aluminum oxide, etc. can be mentioned.

[0039]When a surface coated layer consists of a layered product of a low refractive index layer and a high refractive index layer, outstanding acid-resisting performance -- and -- increase --

by selecting suitably a substance which can give acid-resisting performance to an optical element, and constitutes a low refractive index layer and a high refractive index layer, Wavelength division performances, such as beam splitter performance, reflective mirror performance, transparent conductive ability, a band pass filter, and a dichroic filter, can be given to an optical element. A formed surface coated layer has good adhesion with a substrate, and it is hard to generate exfoliation and a crack, therefore this optical element has good endurance. As a desirable low-refractive-index substance which forms a low refractive index layer here, As a desirable high refractive index substance which can mention silicon oxide, magnesium fluoride, an aluminum oxide, etc., and forms a high refractive index layer, A mixture of titanium oxide, and zirconium oxide and titanium oxide, titanium oxide and a mixture of oxidation PURASEOJIUMU, A mixture of zinc sulfide, cerium oxide, zirconium oxide, indium oxide, tin oxide, and indium oxide and tin oxide, a mixture of tin oxide and antimony, etc. can be mentioned.

[0040]The especially desirable optical property of a low-refractive-index substance and a high refractive index substance which combines and is revealed by this combination is shown in Table 1.

[0041]

[Table 1]

低屈折率物質	高屈折率物質	光学特性			
		I	II	III	IV
フッ化マグネシウム	――――	○			
酸化シリコン	――――	○			
フッ化マグネシウム	酸化セリウム	○			
酸化シリコン	酸化セリウム	○	○		
酸化シリコン	酸化ジルコニウム	○	○		
酸化シリコン	酸化ジルコニウム＋酸化チタン	○	○		○
酸化シリコン	酸化インジウム＋酸化スズ	○		○	
酸化シリコン	酸化チタン＋酸化プラセオジウム	○	○		○
酸化シリコン＋フッ化マグネシウム	酸化チタン＋酸化ジルコニウム	○	○		○
	酸化チタン＋酸化プラセオジウム	○	○		○
酸化アルミニウム	酸化チタン	○	○		○
酸化アルミニウム	酸化チタン＋酸化プラセオジウム	○	○		○

[0042]the inside of Table 1, and I -- acid-resisting performance -- and -- increase -- reflection

performance -- II shows beam splitter performance, III shows transparent conductive ability, and IV shows wavelength division performances, such as a band pass filter and a dichroic filter.

[0043]It is preferred that a layer formed right above a surface layer among layers which constitute a surface coated layer consists of a metallic oxide, silicon oxide, and magnesium fluoride so that I may be understood also from Table 1.

[0044]Although a surface coated layer can be formed by any means of deposition treatment and weld slag coat processing, it is preferred to form by deposition treatment from a viewpoint of maintaining accuracy of an optical element.

[0045]Deposition treatment can be performed within vacuum devices shown in drawing 1, after a surface-layer formation process is completed. In this case, after deposition treatment suspends an exposure of an ion beam, it may be performed, and it may be performed, continuing an exposure of an ion beam. When performing deposition treatment, continuing an exposure of an ion beam, it may carry out changing suitably a kind of introductory gas, a flow, accelerating voltage of an ion source, and ion current according to a deposition material. It is preferred to perform deposition treatment, supplying gas containing oxygen elements, in using silicon oxide as a deposition material, and it is preferred to perform deposition treatment, supplying gas containing oxygen elements and/or a fluorine element, in using magnesium fluoride as a deposition material. By performing deposition treatment under existence of this gas, it cannot be concerned with whether gas is ionized or not but membraneous quality of a surface coated layer can be raised.

[0046]

[Example]Hereafter, although the example of this invention is described, this invention is not limited to these.

[0047](Example 1) Two or more substrates made of polymethylmethacrylate resin (henceforth "PMMA resin") have been arranged in the vacuum devices 1 shown in drawing 1. Inside the vacuum devices 1, "MarkII" (made by the U.S. Commonwealth company) is arranged as the ion source 2, and introductory gas is supplied to the ion source 2 through the gas mass flow control valve 5 and the flow instrument 6 from the introductory gas supply source 4.

[0048]After exhausting the inside of the vacuum devices 1 until the degree of vacuum was set to 1×10^{-5}Torr, oxygen gas was supplied to the ion source 2 by flow 30SCCM. Cathode voltage (accelerating voltage of an ion source) of the ion source 2 120V and anode current were set as 2A, the ion beam was generated, the surface of the substrate currently supported by the electrode holder 3 was irradiated with the ion beam for 10 minutes, and the optical element of this invention was obtained. When ion irradiation was suspended and the optical element was taken out, the surface was assuming the umber color a little. When reflectance was measured with the spectrophotometer, reflectance characteristics as shown in drawing 2 were acquired.

In the figure, a dashed line shows the reflectance characteristics in the substrate which did not perform ion irradiation processing. It is understood that the optical element of this example shows reflectance characteristics lower than the substrate which did not perform irradiation treatment in all the fields of visible light from the result of drawing 2.

[0049](Example 2) Anode current Except having set it as 1.5A, the ion beam was generated like Example 1 and the surface of the substrate currently supported by the electrode holder 3 was irradiated with the ion beam. Deposition treatment was started after progress for 3 minutes with the electron gun 7 arranged in the vacuum devices 1, with ion irradiation continued. Silicon oxide (SiO_2) is used as a deposition material, and it is an evaporation rate. It is considered as a second in 0.5nm /, and the display of the crystal oscillator thickness gage 8 Deposition treatment was suspended in the place which amounted to 100 nm, and the optical element of this invention was obtained. When the optical element was taken out and reflectance was measured with the spectrophotometer, reflectance characteristics as shown in drawing 3 were acquired. It is understood that the optical element of this example shows the dramatically outstanding acid-resisting performance from the result of drawing 3. Also when the substrate made of amorphous polyolefin resin (for example, trade name by Japan Synthetic Rubber Co., Ltd. "ARTON") was used, the effect equivalent to Example 2 was acquired.

[0050](Example 3) It replaced with the substrate made of PMMA resin, and two or more substrates which consist of amorphous polyolefin resin (made by Japan Synthetic Rubber Co., Ltd.) have been arranged in vacuum devices. After exhausting the inside of the vacuum devices 1 until the degree of vacuum was set to $1x10^{-5}$Torr, gaseous carbon tetrafluoride (CF_4) was supplied to the ion source 2 by flow 30SCCM. Cathode voltage of the ion source 2 130V and anode current were set as 2A, the ion beam was generated, and the surface of the substrate currently supported by the electrode holder 3 was irradiated with the ion beam. Deposition treatment was started after progress for 3 minutes with the electron gun 7 arranged in the vacuum devices 1, with ion irradiation continued. Magnesium fluoride is used as a deposition material and it is an evaporation rate. It was considered as a second in 0.6nm /, deposition treatment was suspended in the place where the display of the crystal oscillator thickness gage 8 amounted to 110 nm, and the optical element of this invention was obtained. When the optical element was taken out and reflectance was measured with the spectrophotometer, reflectance characteristics as shown in drawing 4 were acquired. It is understood that the optical element of this example shows the dramatically outstanding acid-resisting performance from the result of drawing 4.

[0051](Comparative example) Two or more substrates made of PMMA resin have been arranged in the vacuum devices shown in drawing 1. After exhausting the inside of the vacuum

devices 1 until the degree of vacuum was set to 1x10 $^{-5}$Torr, the electron gun 7 in the vacuum devices 1 performed deposition treatment, supplying oxygen gas by flow 30SCCM. Silicon oxide is used as a deposition material and it is an evaporation rate. It is considered as a second in 0.5nm /, and the display of the crystal oscillator thickness gage 8 Deposition treatment was suspended in the place which amounted to 125 nm, and the optical element was obtained. When the optical element was taken out and reflectance was measured with the spectrophotometer, reflectance characteristics as shown in drawing 5 were acquired.
[0052]When the existence of generating of the crack by evaluation of the adhesion force by a tape test and an elevated-temperature dry-maintenance-of-idle-boiler test (60 **x 3 hours) was investigated about each of the optical element obtained by the above-mentioned Examples 1-3 and a comparative example, as shown in Table 2, each optical element of this example showed the good performance.
[0053]
[Table 2]

	付着力（10回中テープ剥離回数）	クラックの発生（光透過率への影響）
実施例 1	3 回	微量（光透過率低下なし）
実施例 2	1 回	微量（光透過率低下なし）
実施例 3	0 回	全くなし
比較例	3 回	あり（2％以上の光透過率低下）

[0054]
[Effect of the Invention]the acid-resisting performance excellent in the optical element of the 1st invention -- and -- increase -- it has acid-resisting performance and can respond to highly precise optical systems, such as a laser optics element. And since a surface layer is a reforming layer which an inorganic substance was not laminated directly, and refining of the surface of a substrate was carried out by plasma irradiation or ion irradiation, and was formed on the surface of a substrate, its adhesion with a substrate is good and it has good endurance that it is hard to generate the film peeling and the crack resulting from the difference of a coefficient of thermal expansion.
[0055]the acid-resisting performance in which the optical element of the 2nd invention was further excellent -- and -- increase, while having acid-resisting performance, By selecting suitably the substance which constitutes a surface coated layer, optical properties, such as wavelength division performances, such as beam splitter performance, reflective mirror performance, transparent conductive ability, a band pass filter, and a dichroic filter, can be

revealed. And a surface coated layer has good endurance that adhesion with a substrate is good and it is hard to generate the film peeling and the crack resulting from the difference of a coefficient of thermal expansion via a surface layer.

[0056]without it uses means, such as the usual deposition treatment and weld slag coat processing, according to the manufacturing method of the optical element of this invention -- good acid-resisting performance -- and -- increase -- the optical element which has acid-resisting performance can be obtained.

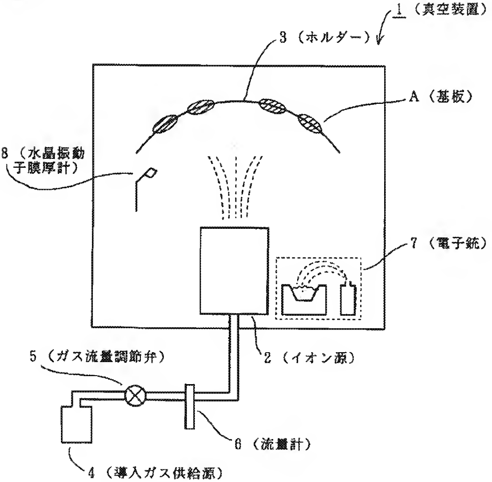
[Translation done.]

* NOTICES *

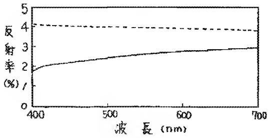
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

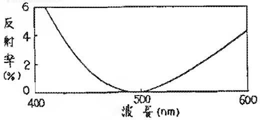
[Drawing 1]



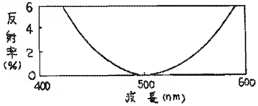
[Drawing 2]



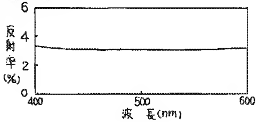
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]